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CONSTRUCTION OF A NEW CEMENT PLANT

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The article describes a new Portland cement manufacturing plant operating by the wet process which has been projected and designed by the Cement Division of the VEB Schwermaschinenbau „Ernst Thälmann", Magdeburg (Fig. 1). Projecting and design of this plant, which has an output capacity of 2400 t : 24 h, are based on the comprehensive experience accumulated in the development of cement machine construction during recent years.

1 Dressing of the Raw Materials

The raw materials used for the production of Portland cement, which consists of about 65% of lime, 25% silica, 7% alumina, and 3% iron, include chiefly limestone, marl, and clay. These materials are first mixed in the proportions required, the thoroughly mixed batches are then roasted and sintered, and finally the resulting clinkers are ground to cement.

The choice of the dressing processes employed for this purpose depends on a number of important factors. Raw materials of high water contents, such as chalk of soft marl, can only be dressed satisfactorily by the wet method, while for dry raw materials the application of the dry process is preferable.

The wet process of dressing these raw materials may often be used even for dry or weakly moist raw materials since this method is characterized by a higher degree of simplicity and reliability than the dry method. This applies particularly to the raw materials with greatly differing lime contents, which yield high-grade cements more easily and reliably by the wet process of dressing. Enquiries from foreign countries also refer chiefly to wet dressing plants, and the considerations outlined above also governed the selection of the project discussed in this publication. The raw materials considered were limestone or marl and an elutriable clay.

2 Crushing Plants

2.1 Coarse Crushing Plant

The plant design was based on the assumption that the excavated blocks to be crushed exhibited side lengths of up to 1 m. The first crushing aggregate therefore consisted of a coarse crusher of 1800 mm jaw width and 1400 mm jaw breadth, developing a crushing capacity of up to 4000 tons of ore per hour to lump sizes of 0 mm—300 mm (Fig. 2). The power required for this large crusher amounts to about 130 kW. For starting the crushing aggregate two such motors of 130 kW each are used in parallel, while operations themselves are effected with only one motor.

71" 55" 12"

The limestone is transported to the crushing plant with automatic discharging large-space cars of 60 tons carrying capacity. The ore is discharged into a pit and is pushed through a double-sided charging device towards the hopper of the grates. The receiving grates of 2025 mm width and 7500 mm length push the coarse materials slowly to the crushing jaw of the coarse jaw crusher. The crushing capacity of the aggregate can be adjusted by regulating the speed of the pole-reversing grate motor.

295" 80"

[1]) Translation of the German publication in „Die Technik", Vol. 12 (1957) No. 8 pp. 574—579.

A chain conveyor fitted with six endless heavy anchor stud chains serves as braking device for the crushed material dropping on to the trough-conveyor belt from the crusher, thus protecting the conveyor belt of 1400 mm width which transports the coarse-crushed limestone into the second crushing plant located at a distance of about 95 m.

2.2 Second Crushing of the Limestone

A bunker holding 20 cu. m. of ore stores the crushed material arriving from the coarse jaw crusher. Two plate belt conveyors of 1600 mm width and 3200 mm length each transport this material over two charging chutes to two rapid hammer crushers of 1400 mm rotor diameter, built by the VEB Maschinenfabrik Polysius, Dessau (Fig. 3), and designed to crush the precrushed limestone to lump sizes of 0 mm—50 mm. The power required for these crushers is 250 kW each. The units are driven by directly coupled electric motors, the operating speed of the rotor being maintained at 720 r. p. m. The crushed material is transported by an inclined trough belt conveyor of 1200 mm width fitted with reversing brake over a distance of 105 m and up to a height of 24 m.

63" 126" 55" 2"

2.3 Third Crushing of the Limestone

2"

The limestone crushed to a lump size of 0 to 50 mm drops over a Y-chute on to two inclined trough belt conveyors of 1000 mm width and 11 mm length fitted with reversing brake over two three-way chutes with guide flaps, stop gates and four screen charging chutes on to four double-deck universal swing screens. The screens are 1500 mm wide and have a length of 3750 mm, ... the size of meshes being 10 mm. The material passing over these screens is transported over four chutes to two further horizontal trough belt conveyors of 1100 mm width and 18000 mm length to two Y-chutes with reversing flaps and into two rapid hammer crushers of 1400 mm rotor diameter. The output capacity of this crusher amounts to about 150 tons material of 0 to 8 mm lump size at a power requirement of 250 kW. Another rubber belt conveyor then conducts the crushed and screened material over corresponding reversing and guide chutes on to a large inclined conveyor belt 1200 mm wide, which conducts the finish-crushed limestone material over two chain conveyors into the grinding mill bunkers or to the large storage hall.

39" 59" 148" 0.4" 43" 59 ft. 0,32"

3 Crushing and Elutriation of the Clay

The clay is transported to the plant in large-space cars of 60 t carrying capacity, the same as for limestone, and is discharged into reinforced bunkers at two points of discharge. The clay to be crushed is removed by two double-sided charging devices on to two plate belt conveyors of 1200 mm width and 41000 mm length each and is finally conveyed over two charging chutes on to two roller crushers of 1250 mm diameter and 1250 mm width each. The roller crushers are fitted with toothed rolling rings, pushed over cast iron roller cores. One of these rollers has fixed bearings while the other roller is displaceably mounted, each roller being provided with its own drive. The grooves of the rollers are cleaned by means of a special cleaning device.

4 ft. 135 ft. 49" 49"

Karl Alwintz

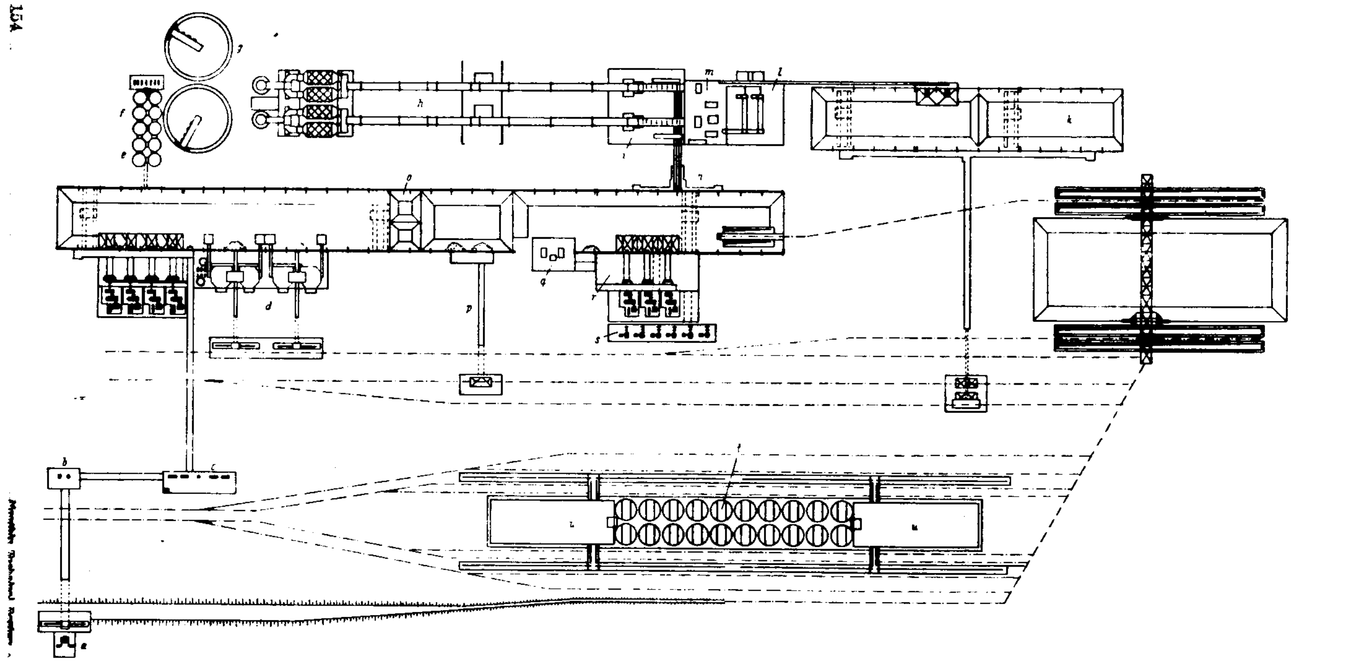


Fig. 1. Plan of a cement manufacturing plant

- a Limestone first crushing treatment
- b Limestone second crushing
- c Limestone third crushing, screening and transport to the stores or to the grinding mill
- d Preliminary clay crushing and elutriation
- e Clay slime silos (4)
- f Clay slime silos (6)
- g Two stirrer agitators for crude slimes
- h Rotating furnace plant consisting of two rotating kilns of 4.5 m (15.75 ft.) diameter and 170 m (558 ft) length, each provided with electric flue-dust precipitation and with a flue-dust ring charger.
- i Two grate coolers of the rotating kilns
- k Coal storage
- l Coal drying plant
- m Coal crushing plant
- n Clinker transport from the grate coolers to the clinker stores
- o Store rooms for fluorspar and purple ore (blue billy)
- p Gypsum crushing plant, gypsum and slag transport to the stores, to the drying plant
- q Slag drying plant
- r Cement mills
- s Compressor plant
- t Cement silo plant with 20 silo cells
- u Two cement packing plants equipped with circular packing machines

The crushed clay pieces from the roller crushers (of up to 100 mm lump size) are either transferred to the elutriating plant directly or are transported to the clay storage in the storage hall for later treatment. Elutriation is effected as follows:

The crushed clay is transported from the storage hall by 35'
a grab crane and four ascending plate conveyor belts of 870 mm
69' width and 21000 mm length, designed for four adjustable
travelling speeds, to the elutriators of 12000 mm diameters. 39.4'
Each elutriator requires a power of about 80 kW. Four electrically operated valves control the flow of water into the aggregates, the water contents of the clay slimes being permanently controlled by continuous flow viscosimeters. Three centrifugal slime pumps of the type MBR 250/500 are provided for the transportation of the clay slimes from the elutriating apparatuses to the clay slime charging points at the mills or the clay slime silos. Ten silos are provided, four for the clay slimes and the other six for the crude cement slimes. Every one of the slime pumps, designed for a power of 110 kW, conveys 250 cu. m/h of slimes of 50 percent, water contents to a height of 50 m.

Fig. 3. Rapid hammer crusher for limestone

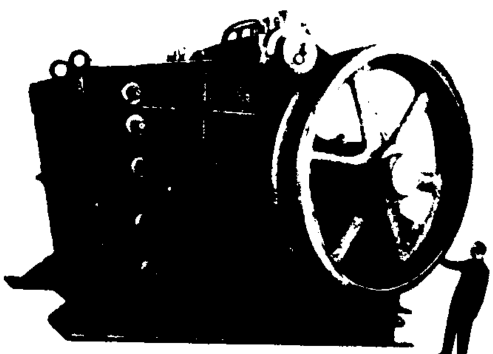


Fig. 2. Large jaw breaker for limestone

The elutriating machines consist of concrete containers of 12000 mm diameter each. Two rakes fitted with round iron bars rotate within the container, crushing and elutriating the clay lumps located in the water until a clay slime of 50 to 60 percent of water contents has been formed.

4 Sliming Mills

The limestone material crushed to lump sizes of 0 mm to 8 mm is mixed with clay slimes in three-chamber tube mills to a free-flowing slime of about 36 to 40 percent solid materials. The limestone is transported by a grab crane into the concrete bunkers above the sliming mill charging points – unless they are transported to this point directly from the crushing mills. The other admixtures are transported to their own containers in the same way. A weighing station, consisting of automatic triple-dosing scales, is arranged beneath everyone of the storage bunkers provided at this point. The first continuous flow dosing scale, designed for a dosing range of 15 to 75 t/hour, is used for the weighing of the limestone of 0 to 8 mm lump size, the second scale, with 2 to 10 t/hour weighing capacity, is employed for the weighing of the purple ore of 0 to 10 mm lump size, while the third scale, of the same weighing range, is reserved for the fluorspar of 0 to 25 mm lump size.

The addition of the purple ore and the fluorspar tend to reduce the sintering temperatures of the crude slimes, effecting a corresponding reduction of coal consumption. The charging hoppers of the mills are fitted with special chutes permitting the checking of the accuracy of the automatic scales. The clay slimes are conveyed to the mills over a double clay slime charging device with measuring containers of 500 litres capacity each.

The cement manufacturing plant is provided with four
tube mills. The diameter of each aggregate amounts to 3200 mm, 10.5'
at a length of 15000 mm (Fig. 4). The end walls of the grinding 49'
tubes, constructed of strong steel plates welded together and lined with manganese hard-steel plates, are fitted with cast-on hollow pinions of large diameters, used as bearing pivots for the mill bodies. The material to be ground is introduced through the hollow pivot of the charging end of the mills, while the hollow pivot located on the discharge end of the mill conducts the ground mixtures out of the mill and serves for the fastening of the coupling sleeve of the Centra-drive of the mill.

The interior of the mill is subdivided into three chambers by intermediate walls. These chambers are filled with grinding bodies taking up about 25 percent of the available grinding space. The first chamber of the mill contains 25 tons of steel

Fig. 4. Multi-Chamber mill for slimes

5.9 3.14 2.36

balls of 100 mm, 80 mm and 60 mm diameter, the second chamber is filled with the same weight of balls of 50 mm and 1.96
1.57 40 mm diameter, while the third chamber is loaded with about 75 tons of steel rod sections of 25 mm diameter and 27 mm length as well as of 18 mm diameter and 25 mm length. The power required for these mills depends on the charge and averages about 1650 kW for the minimum charge weights and to 2100 kW for maximum charge.

2210 HP 2820 HP

The multi-chamber tube mills are driven by electric motors, developing 1000 r.p.m. The rotary speed of the grinding tube amounts to about 18 r. p. m. and is reduced from that of the motors by two coupled dust- and oil-proof precision gear wheel drives over a coupling spindle (Centra-drive). Previous to starting the mill, the electric starting pump of the gear is switched on, which simultaneously supplies all bearing and gear-meshing parts of the gear with oil, while during operation the bearing points are lubricated from the automatic gear oil pumps attached to the gear. The mill-operating motor cannot be started before the starting oil pump has been operating for a short period of time, and the latter is automatically stopped after starting the mill-operating motor. The coupling spindle introduced between grinding tube and gears permits the execution of certain longitudinal and vertical movements, protecting the gears against shocks and blows as well as excessive stresses due to deviating vertical positions of the grinding tube.

The multi-chamber mills are provided with a starting device consisting of a small accessory driving motor, which is connected with the starting device over a small gear aggregate mounted in the first driving gear. As soon as the main motor is started, the overtake-coupling of the accessory gear and its motor are automatically cut off. In this way a very soft starting of the mill is obtained. It is also possible by this means to control the operation of the mill at reduced speed in such a manner that it can be stopped in any position desired.

Each of the four multi-chamber tube mills grinds in one hour about 80 tons of raw material into fine slimes, leaving a residue of 8 to 10 percent on test sieves of 4900 meshes/sq.cm.

5 Slime Silos and Slime Mixing Plant

The ground slimes emerging from the mill are collected in a pit, from where they are conveyed into the storage tanks for crude slimes by means of centrifugal slime pumps. The plant is provided with ten slime tanks of 8000 mm diameter 26.2'
82' and of 25 000 mm height. Four of these tanks contain the clay slime, while the remaining six are used as homogenizing tanks for the raw slimes. The contents of the tanks are well adjusted in accordance with their chemical compositions and are finally mixed to specifications. Mixing operations are effected by means of compressed air of about 5 atm. (above atmospheric pressure) which is blown into the container through a number of nozzles. The compressed air is conducted through the automatic compressed air distributors mounted in the compressed air pipe system, so that mixing operations can be restricted to one or two containers, if desired. Seven pumps of the type NBR 250/500, mounted in a common pump pit in front of the silo battery, suffice to take care of the entire slime transport. Two of these pumps are employed for the conveyance of the clay slimes from the tanks to the tube mill, two others for the circulation of the slime for the purpose of homogenization, two pumps for the movement of the slimes from the agitators to the furnaces, while one pump is used as spare pump.

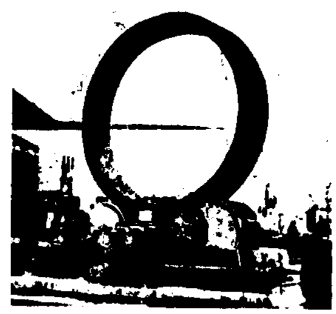
The slime stores for the conditioning of the cement mixtures are collected in two large stirring gear agitators of
115' 35 000 mm diameter and of a storage capacity of 6000 cu. m. These agitators are filled with the well-mixed (adjusted) slimes from the slime tanks and consist of cylindrical concrete containers provided with central foundations, carrying the rotating bridges, whose other ends move on the edges of the tank. The rotating bridges (which can be mounted by the operators) are fitted with four stirring-blade gears each. The gears are operated individually over reduction gears. Each bridge is also provided with a compressor of 240 cu. m. suction capacity for blowing through the planet stirrer. The power required for each bridge amounts to 15 kW, that for a stirring vane to 4.5 kV. After conditioning in the agitators the slimes are ready for transport to the two sintering furnaces.

6 Calcination of the Raw Materials

6.1 *Cylindrical Rotary Kilns*

The tube in the rotating furnace operating on the countercurrent principle (the cement material to be sintered travels against the direction of the heating gases) is designed for an inclination of 3 to 4 percent and rotates at a speed of 0.8 to 1.0 r. p. m.

Fig. 6
Rotating kiln bearings with barrel ring



The slimes are introduced into the kilns through an inclined tube, penetrating into the calcining drum. Directly after its entrance into the furnace the slimes pass a short filter section in which the widely distributed slimes remove coarse flue dust particles from the heating gases. Following the filter section of the kilns the slimes pass through about one third of the entire tube length, in which marine (ships) chains are suspended like curtains. The slimes adhere to these chains and are rapidly dried by the passing hot gases. The dry material drops from the chains and is strongly heated on its further passage through the drum. At about 800° C the carbon dioxide escapes from the material, which finally becomes soft at temperatures of about 1400° C, sintering to small spheres of 1 to 20 mm diameter. The entrance end of the kiln is connected with a suction blower and the chimney through a dust chamber containing an electrical horizontal dust-precipitating plant. The separated dust is collected in discharge hoppers of the dust separation aggregate and is returned into the system over pneumatic conduits and a bucket conveyor or by means of a pneumatic screw pump.

The kiln is heated with coal dust blown into the combustion chamber by a high-pressure blower and is burned by the hot fresh air drawn from the cooling aggregate.

The calcining tube constructed of welded boiler plates has a diameter of 4500 mm and a length of 170 m. It is fitted with interior angle rings arranged at certain distances in such a manner that the refractory lining is securely held in place under the operating conditions involved. The tube rotates in eight barrel rings moving on roller systems (Figure 5). Rollers as well as barrel rings are made of cast steel, and the distances between the barrel rings are chosen in such a way that only one size of roller bearings is required, improving the spare part situation considerably. In order to protect the inclined calcining tube from rolling off the bearings, the latter are adjusted accordingly and are provided with two vertical pressure rolls at both sides of a barrel ring next to the driving aggregate.

The rotating rings are of rectangular cross-section and are arranged in such a way that thermal stresses are avoided, besides inducing a reinforcing influence on the calcining drum. The bearings pertaining to one barrel ring, which are mounted on a common heavy double bearing pedestal, are provided with forced circulation lubrication and automatic water cooling. Lubrication is arranged so that the bearings are supplied with sufficient oil even during the slowest movements of the drum. The bearings are also protected against the radiating heat from the calcining drum.

Operation of the rotating kiln is effected over a two-parted gear rim securely fixed to the calcining drum (Figure 6).

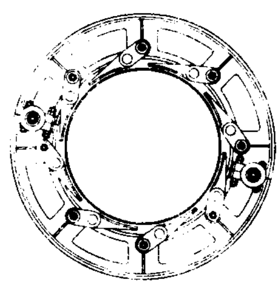


Fig. 6
Rotating kiln gear rim

The rim engages a pinion gear located on the driving shaft of a multi-stage precision gear operated by an electric motor of 300 kW, developing 750/375 r. p. m. This gear is supplemented by an auxiliary gear fitted with a corresponding electric motor which, in case of a break-down of the main driving aggregate, is able to rotate the drum at a speed of up to 4 r. p. m., thus preventing one-sided cooling of the drum which would cause a distortion of the long calcining tube. The auxiliary gear is also required for the starting of the kiln and, for this purpose, is connected with a speed-controlled coupling, throwing out the auxiliary gear as soon as the speed of the system overtakes that of the coupling. The main drive is also provided with an automatic brake, preventing reversal of the drum motion in case of sudden standstills.

Feeding of the slimes to the kiln is carried out by means of a charging device of adjustable rotary speed, operating synchronous with the kiln motor but capable also of being adjusted from the burner platform.

The discharging end of the rotating drum is closed by a movable brick-lined furnace head fitted with inspection holes and doors. The finished clinkers drop over this head on to an inclined grate cooler "Polysius, Dessau" fitted with a grate
9.2' of 2800 mm width and 17500 mm length, designed for the 57.5'
mechanical transport of the clinkers. Cooling of the clinkers on the grate is effected by means of a cold air blower mounted beneath the grate. The section of the cooler located toward the kiln and containing the hottest clinkers heats the cooling air blown through the clinkers to a temperature of about 600 to 700° C. This hot air is passed through the calcining tube as secondary air.

The clinkers, leaving the coolers at a temperature of only 25° to 50° C, are passed through a crushing apparatus to the clinker storage hall, an automatic recording scale controlling the weight of the product on its way to the storage.

7 Drying and Crushing of the Coal

Crushing of the coal required for the calcining of the clinker materials is effected in a similar way to that of the limestone, i. e. in two hammer crushing aggregates of 1400 mm rotor diameter, constructed by Polysius, Dessau, where the coal is crushed to a lump size of 0 mm to 10 mm. This pre-crushed material is moved by crane and conveyor belt to the coal grinding mill if its moisture contents do not exceed 10%.
Moist coal is first dried in two drying drums of 2600 mm 8.6'
diameter and 20000 mm length each, provided with coal 66'
dust firing (Figure 7). The dried coal is conducted to the bunkers over the charging end of the coal grinding mills by mechanical conveyors. The two rotating coal mills have a diameter
9.2' of 2800 mm and a length of 5500 mm each. They grind 18.1'
16—18 tons of coal p. h. from a lump size of 0 mm to 20 mm to dust, while the moisture (up to 10%) is removed by the circulating air currents in the mills. The coal entering the mills is passed over an automatic recording scale. Each mill is loaded with 38 tons of grinding bodies and requires a power of about 365 kW. The discharging pivot of the mill is fitted with a screening device of 3000 mm diameter in order to retain the coarse coal for further grinding, while the fine dust is transported through a pipe line to the cyclone. Bucket and worm conveyors move the coal dust to the dust containers of the furnace plant. The discharge end of the cyclone is connected with the suction end of the furnace blower, while

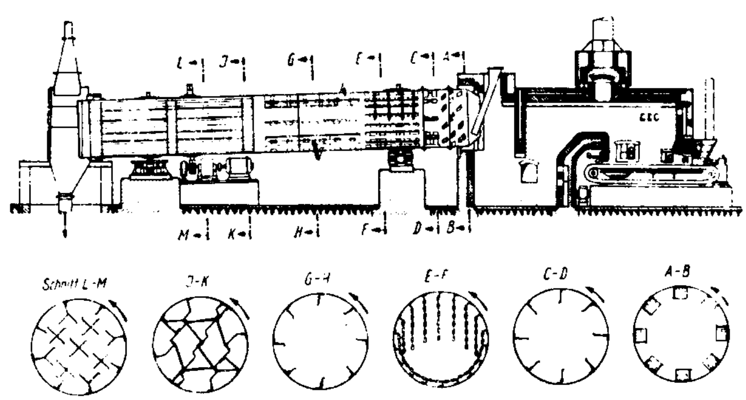


Fig. 7. Drying drum for coal

the discharge pipe of the same blower is fitted with a connection to the charging neck bearing of the mill, closing the conveyor air current circuit in the mill. Coal dust explosions within the aggregates are avoided by the provision of a device introducing inert gas into the air current circuit during starting and stopping periods of the grinding mills.

The coal dust removed from the dust containers by a coal dust charging device and passed on in a pipe line is blown into the kilns through the burner nozzles by means of a high-pressure blowing aggregate. The working capacity of the blower amounts to 50000 cu. m. of air per hour at 70 C and at 1000 mm WC compression. The power required for this blower is 220 kW at 1185 r. p. m. One third of the air required for the calcination of the clinker materials is introduced through the furnace blower, while the remaining two thirds are supplied as secondary preheated air through the cooling section and the furnace head. The cooling air, heated by the clinkers to 600 —700 C, raises the temperature within the sintering zone of the kilns to 1600 —1700 C. Sintering of 1 ton of clinkers in the large rotating kiln furnaces described here requires about 1325 to 1350 Cal, so that at a daily output of 1200 tons of clinkers about 12.5 tons of coal dust are burned per hour and furnace. 85

8 Drying and Crushing of added Materials and Gypsum

These raw materials are transported from the railway cars over two plate belt conveyors of 1120 mm width and 4500 mm length on to an ascending rubber belt conveyor of 1000 mm width and 70 m length, which moves the gypsum of up to 350 mm lump size or slag of up to 150 mm lump size to the hammer crusher of 1400 mm rotor diameter. The materials are reduced to a split size of 20 mm, the output capacity amounting to 150 tons of gypsum or 120 tons of blast furnace slag per hour. A travelling grab crane moves the crushed material to the storage hall or to the bunkers above the charging point of the cement grinding mill, while the slag is conveyed to the drying plant.

8.1 Drying of the Blast Furnace Slags

The wet broken slag is moved from the storage bunkers over rotating disk feeders of 1800 mm diameter to two rapid drying aggregates of 2800 mm diameter and 6000 mm length each. The dryers are fitted with two impeller shafts and a wear-resisting lining and are heated by coal dust firing. The hourly output capacity of each dryer amounts to 22.5 tons of slag at a power requirement of 40 kW and at a reduction of the water contents of from 25% to 1%.

Two vertical electric filters are provided for the removal of dust from the slag drying plant.

9 Cement Grinding Mill

Fine-grinding of the cement is effected in multi-chamber tube mills of the same design as the slime mills.

The mills are filled with 115 tons of grinding elements each. The power required averages about 1650 kW and can eventually be raised to 2100 kW. Clinkers, gypsum, and slag are conducted to the mill over automatic triple-dosing scales from the bunkers. Operation of the mill produces a considerable quantity of frictional heat so that fresh air has to be introduced continuously. The air passed through the mill and filled with dust is cleaned by passage through three electric dust separating plants, cleaning 16.7 cu. m. of air per second at a dust content of 100 g/cu. m.

The grinding capacity of the mill amounts to about 50 tons per hour. The fineness of the product shall be maintained in such a way that a test screen of 4900 meshes shall leave a screening residue of 6 to 8%.

10 Cement Silos and Packing Equipment

Two double worm pumps (one serving as reserve pump) are mounted beneath each cement mill. The cement fed to these rapidly rotating worms is loosened up considerably and is emulsified by a current of compressed air (about 4 atm.) to such an extent that it moves through the pipe lines like a liquid. The cement pumps are connected with the cement silo by a pipe system. The silo consists of 20 silo cells of 1200 mm diameter and 26000 mm effective height each. All silo cells are provided with slightly inclined floors covered with a system of porous plates through which compressed air is forced. The well aired and comparatively light cement masses move upward while the heavy airless masses on top descend so that as a final result of the internal motion of the cement thus induced the bunker contents are well homogenized and cooled. The compressed air is passed through a compressed air filter before it is introduced into the cement. All locking slides and valves within the cement conveying pipes are designed for remote control. 39.5'

Each silo cell is provided with four bottom-emptying apparatuses (Figure 8). Two of these units are employed for the transport of the cement into the packing plant, the other two serving for the charging of cement tank cars for direct railway transport without packing.

The well aerated cement is conducted to the inclined conveying conduits which are lined with porous ceramic plates. A blower or compressor forces finely distributed air through the plate pores into the conduit, thus inducing the cement to flow off. The conduits open into four bucket elevators. By them the cement powder is lifted into containers

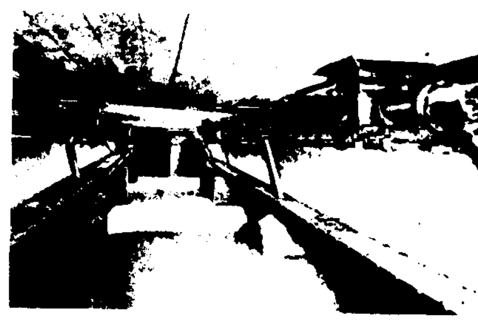


Fig. 8. Pneumatic emptying of silos with pneumatic conduits

arranged above four rotating valve bag packing machines (Fig. 9) located at the ends of the silo plant in two [illegible] packing departments. So-called screening worms mounted in the line in front of the containers separate coarse pieces of clinkers or foreign substances from the finely powdered cement. Each packing machine is fitted with 14 bagging sockets in circular arrangement. The machines operate fully automatic with the exception of the fastening of the bags which travel around the machine and, after filling up with a weighed quantity of cement, drop on to an inclined bag conveyor belt. Each of the four rotating packing machines is fitted with three electric motors, one for the stirring equipment, one for the rotation of the machine and the third one for the bag conveyor belt, at a total power output of 10.2 kW. Each packing machine fills in one hour 1900 bags with 50 kg cement

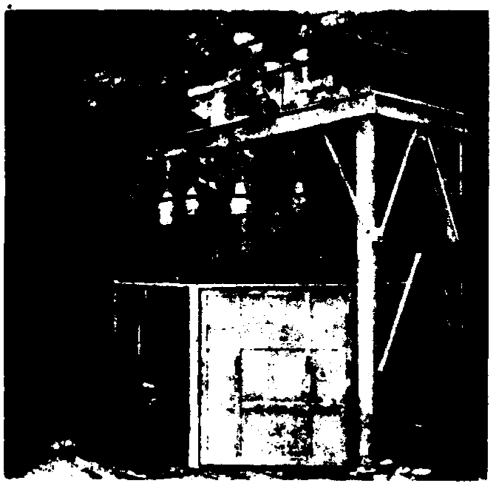


Fig. 9 Bag-packing machine with rotating valves

each, while a system of rubber conveyor belts distributes the filled cement bags along the loading platforms for the railway cars or automobile trucks.

It is natural that the packing and the transport of cement causes considerable losses from various sources. Worm conveyors are therefore mounted beneath the bag conveying belts which collect the scattered and sweeping cement of the packing plants and convey this material to the bucket conveyors after passing it through suitable dust screens. Both packing departments are provided with three dust filtering aggregates each in order to prevent the disagreeable and costly escape of large amounts of cement. Two of these aggregates are fitted with 84 filter bags each, the third one with 48 filter bags.

11 Atmospheric Dust Separation

The works departments of the cement manufacturing plant are strongly protected against cement dust losses and corresponding atmospheric contaminations by electrical and filter dust separating aggregates. Apart from the dust separating units provided for the rotating kilns, the slag and coal drying plants, the cement mills and the packing departments, an entire series of suitably dimensioned round filter dust separators have been provided in the limestone crushing plant, for the clinker transports, and for the crushing aggregates for coal and gypsum. This large number of active dust-separating plants ensure not only practically dust-free operation of the entire plant but also the recovery of considerable quantities of valuable cement dust.

12 General Remarks

The weight of the entire cement manufacturing and handling plant without the electrical equipment amounts to about 15175 tons.

The driving gears of the working machines have been designed as single units powered with electric motors, where necessary by the introduction of gears in dust- and oil-proof casings, while belt drives have been avoided as far as possible with the exception of a few Vee-belt drives.

Measuring and controlling devices fitted with recording instruments have been installed wherever required to ensure satisfactory operation of the aggregates.

Provision has been made for the introduction of a sufficient number of lifting tools and equipment for the erection of the entire plant as well as for plant operation later on. This equipment also includes five travelling grab cranes of 20 tons carrying capacity each and a loading bridge of 60 m spread fitted with jibs of 24.5 m length and also designed for a carrying capacity of 20 tons for the transport of materials in the storage halls and to the mills. Passenger and freight elevators on the silo floors and to the operating platform of the rotating kiln charging ends are also to be provided.

A number of special pumps have been provided for the rapid emptying of the slime pumping pits from slime and dirt water.

The compressor plant consists of four turbo-compressors with intermediate coolers and with constant pressure regulation of 5 atm. (above atmospheric pressure), with 6000 cu. m. intake capacity each and a power requirement totalling about 2500 kW.

The equipment provided for the cement manufacturing plant also includes two Diesel-locomotives of 90 h.p. each and two eight-wheel box tipping wagons of 80 tons carrying capacity and 40 cu.m. volume each. Mention should also be made of two heavy vehicle scales for maximum loads of 30 tons and five wagon scales of switch weight design with remote-indicating equipment.

13 Automation

The mill aggregates, the drying units and the rotating kiln plants are all supplied with automation equipment.

The charging of the various materials into the mills according to their weights is controlled so as to conform to certain automatically determined degrees of fineness according to the German Standard DIN 1171.

The same principle is used in the case of the slime-grinding mills, although the attainment of the controlling impulse is much more complicated in view of the fact that the control involves the solid as well as the liquid phase.

Screening of the slimes leaving these mills must also be effected by the wet method, the residues being dried previous to weighing. Nevertheless, the problem has been solved after effecting a few simplifications.

The automation equipment for the rotating kilns and the drying aggregates will be provided in accordance with the system devised by the Institut für Waermetechnik und Automatisierung (Institute for Thermotechnics and Automation) in Jena-Burgau. They are now being tested in a cement manufacturing plant operating by the wet process and in a Lepolan-plant erected by Polysius, Dessau. Automation in this case is based on the maintenance of a constant output of the kilns at uniform flame temperatures and flame length within the calcining units. Charging of the materials into the kilns is effected over an adjustable charging mechanism controlled on basis of the volume weight of the clinkers.

The volume weight of the clinkers is checked at certain intervals with the help of an apparatus developed for this purpose by the Institute mentioned above. The rotary speeds of the kilns and the charging mechanisms are synchronized. The fuel supply is maintained constant and is regulated only in accordance with the caloric value of coal dust used; as long as there is no suitable technical calorimeter available for this purpose, the fuel supply is regulated by the clinker temperatures at the furnace head. In order to ensure uniform preheating of the secondary air, the forward feed of the grates of the clinker cooler is to be regulated in accordance with the temperature of the secondary air.

Automation of the drying plants is carried out similar to that of the rotating kilns.

It is possible to automatize the cement manufacturing plant described to a very large extent in the manner indicated. The equipment is not cheap, but the initial expenses are well justified by the uniform and satisfactory operation of the different aggregates.

14 Conclusion

By close co-operation between the VEB Schwermaschinenbau "Ernst Thälmann", Magdeburg, and the VEB Maschinenfabrik Polysius, Dessau, it has been possible to design a really modern and highly efficient cement manufacturing plant. In carrying out this work, Polysius, Dessau, have not only supplied the construction of the rapidly acting hammer crusher, but also their special experience in the field of pneumatic conveying equipment to be used particularly for the transport of the cement from the mills to the cement silos and to the packing departments. The two latter operating departments have been equipped completely in accordance with the ideas of Polysius, Dessau. It is also planned to equip the plant with a Polysius air-sifting aggregate consisting of three Polysius air-sifting apparatuses of 4 m diameter each, for the purpose of testing the various possibilities of the grinding of clinkers to cement. This old grinding system has again been taken up successfully during recent years in a number of countries.

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Approved For Release 2009/07/09 : CIA-RDP80T00246A004000210002-2